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PSYCHE

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A NEW MYRMECOPHILOUS SCARABAEID BEETLE FROM THE PHILIPPINE ISLANDS WITH A REVIEW OF *HAROLDIUS* [1]

By Pe. F. S. Pereira C.M.F.
Departamento de Zoologia, São Paulo, Brasil

I have recently received from Dr. P. J. Darlington a short series of a scarabaeid beetle of the genus *Haroldius* from the Philippines. According to Dr. Darlington, who collected them, "All 6 specimens of the beetle were taken in one nest of ants under a stone in forest. Dr. W. L. Brown tells me that the ant is a *Diacamma* of the group *vagans* F. Smith of the tribe Ponerini." The specimens are markedly different from *Haroldius globosus*, the only species of the genus previously known from the Philippines.

Dr. Darlington has kindly donated two of the specimens to the Departamento de Zoologia; one of these has been dissected and upon examination of the genitalia proved to be a female. No sexual dimorphism being apparent in undissected specimens, I have decided not to attempt a study of the male genitalia until more material is available.

Haroldius philippinensis, n. sp.

(Figs. 1-10)

Length: 3.5-4.0 mm.; humeral width: 2.5-3.0 mm.

Shape oval, broadest at middle of elytra; color black with brown overtones on anterior margin of clypeus, sides of elytra, legs, and under parts of body.

[1]Published with a grant from the Museum of Comparative Zoology at Harvard College.

Head: Clypeus (fig. 2) finely punctate, more densely so in front, its anterior margin with sharp parallel denticles separated at base by a well-defined longitudinal sulcus. Genae separated from clypeus by one well-defined sulcus, not denticulate in front; posterior angles acute. Dorsal aspect of eyes small. Mouth-parts (figs. 1, 4) with 4-segmented labial palpi; first segment short and robust; second shorter and thinner than first; third as long as first plus second, thicker than either, oval-shaped; all three proximal segments with bristles; fourth segment thin and short. Maxillary palpi also 4-segmented; first segment very short and thin; second much longer than first, apically dilated; third with sub-parallel sides, a little longer than first, as thick as apex of second; fourth much longer than three proximal ones together, a little thinner than third, narrowed towards tip. Antennae (fig. 3) 8-segmented, first segment much longer than four next ones together, with a median constriction; second and third sub-equal, subcylindrical, third somewhat dilated towards apex; fourth and fifth sub-equal, shorter than third, wider than long; sixth to eighth forming lamellae of decreasing size, of which first is much longer than third to fifth segments together; second lamella sub-equal to first; third lamella much shorter.

Prothorax: pronotum (fig. 2) much broader than long, smooth, with a series of elongate punctures near posterior angles, vanishing towards middle; a small round fovea in front of each posterior angle; no foveae on sides; anterior angles rounded, posterior poorly-defined. Anterior part of prosternum with a deep depression, separated from posterior part by a keel which runs from near coxae to lateral margin of prosternum; prosternal process very wide, smooth.

Mesothorax: Scutellum completely covered by elytra; its anterior part opaque, with numerous punctures and small bristles; posterior part triangular, smooth. Mesoster-

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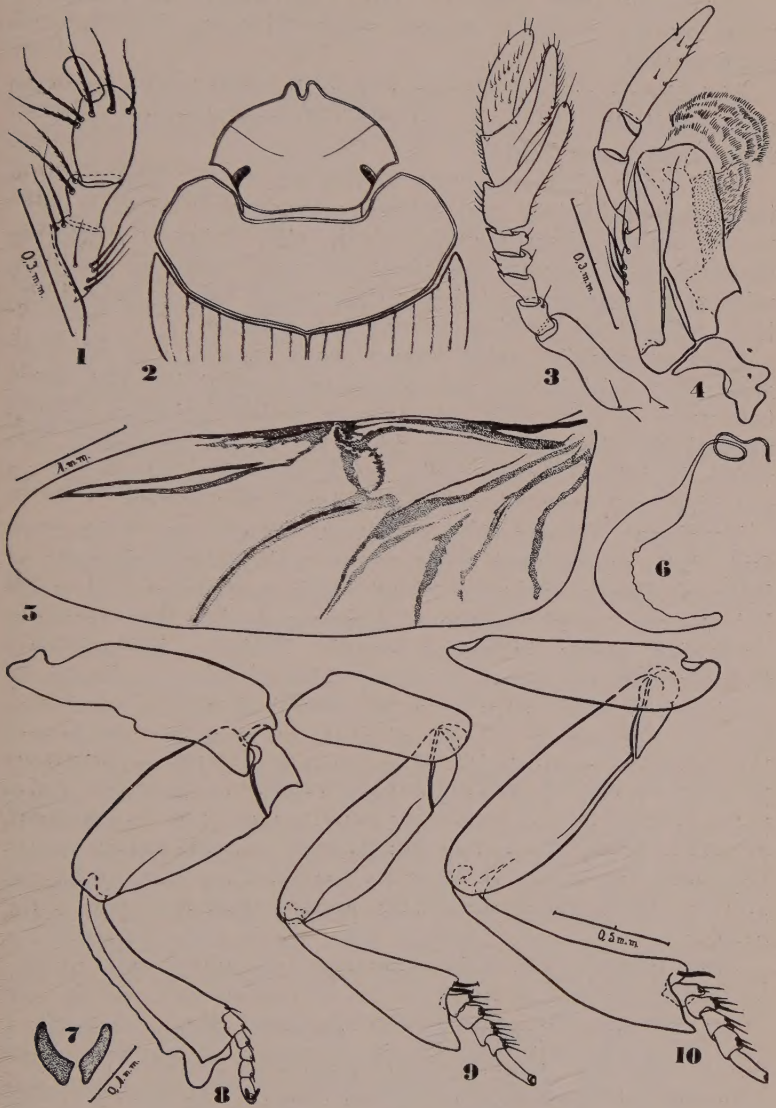
Explanation of Plate 1

Haroldius philippinensis, n. sp. 1. Labial palpi. 2. Dorsal view of head and pronotum. 3. Antenna. 4. Maxillary palpi. 5. Wing. 6. Spermatheca. 7. Claws (much enlarged). 8. Foreleg. 9. Middle leg. 10. Hind leg. Figs. 3, 4, 6, 8, 9, 10 on the same scale.



PEREIRA — HAROLDIUS PHILIPPINENSIS

num smooth, very wide and long, separated from metasternum by an arcuate suture. Mesoepisterna broad, subquadrangular.

Metathorax: Metasternum smooth, very broad between coxae, a little swollen on middle. Metaepisternum wide in front, narrower behind.

Abdomen: Six segments visible at middle, finely punctate; second, third, and fourth segments sub-equal; fifth much longer than fourth; sixth still longer. Posterior sternites with round marginal foveae. Pygidium swollen, with small punctures (visible only under strong magnification); its basal portion weakly emarginate.

Elytra smooth, with seven very weak, not obvious striations, which are not punctate. Interstriae flat, with two rows of pits with microscopic yellow bristles, effaced posteriorly. Anterior angle of elytra acute, produced forward. Epipleurae very wide, with very fine punctures on anterior half, more strongly sculptured posteriorly.

Forelegs: Coxae (fig. 8) long, transverse, with very fine, short pubescence. Trochanters sub-globose, dentate at internal apices. Femora robust, with punctures and small bristles on under surface of apex; anterior face strongly excavated along its entire length. Tibiae a little longer than femora but more slender; thinner basally, gradually dilated apically; only two latero-apical spines and one angular process on middle of anterior margin; upper and lateral faces very finely sculptured and with microscopic bristles; inner and outer faces with somewhat larger bristles. Spurs very short and thin, bristle-like. Tarsi set in foveae at inner corners of tibiae; first segment small, partly hidden in the fovea, so that sometimes only four segments are visible; second, third and fourth segments sub-equal, four-sided, elongate, curved, with narrow tips; fifth segment a little longer than third plus fourth, ending in two short, robust claws.

Middle legs: Coxae (fig. 9) smooth, widely separated, almost parallel (slightly convergent backwards). Trochanters small and elongate. Femora less robust than anterior ones. Tibiae shorter than femora, and much more dilated towards apex, with very minute yellow bristles on upper and lower faces; inner faces with bristle-bearing keels;

outer faces strongly excavated. Spurs minute, bristle-like. Tarsi robust; first, second, and third segment sub-globose, slightly dilated on inner side; fourth segment more cylindrical, a little longer than any of others; each of four basal segments with an internal tuft of bristles; fifth tarsal segment thinner than others, cylindrical, narrower at apex, a little longer than third plus fourth. Claws similar to those of forelegs.

Hind legs: Coxae (fig. 10) long, transversely placed. Trochanters more triangular than middle ones, with some bristles. Femora much longer than middle ones; under surface smooth; one keel on anterior margin; posterior face excavated. Tibiae much shorter than femora, less dilated towards apex than middle tibiae but more strongly arched. Spurs bristle-like. Tarsi similar to those of fore — and middle legs.

The present species can be distinguished from *Haroldius globosus* by the following table:

H. philippinensis n. sp.	*H. globosus* Boucomont 1925
Larger (3.5-4.0 mm.)	Smaller (2.0 mm.)
Black with brownish overtones on front of clypeus, elytra, under parts, and legs	Metallic green with a slight purplish sheen
Elytra pubescent, with striae visible on anterior half and effaced posteriorly	Elytra glabrous, with striae effaced on disc

Type-locality: Dingalan Bay, East Luzon, Philippine Islands.

Type-material: Type and 3 paratypes in the Museum of Comparative Zoology at Harvard College; 2 paratypes (one dissected and mounted on slides) in the Departamento de Zoologia, São Paulo. All collected by P. J. Darlington (VII-VIII, 1945) at the type-locality, in a nest of ants of the genus *Diacamma* (group *vagans* F. Smith, Ponerini).

This genus is scarce in collections. The biology of the species is poorly known. Some of them have been found in ant nests (*H. heimi* with *Pheidole latinoda,* the present species with *Diacamma*). *H. perroti* has been collected with numerous specimens of *Bacanius* (Coleop., Histeridae) by sifting dead leaves.

A list of the species of *Haroldius*

Type of genus: *H. fairmairei* Bouc., by designation of Paulian 1945, 58.

1. *H. calcaratus* Janssens 1934, 33, figs. 1-2. Barway (India).
2. *H. cardoni* Boucomont 1923, 83; Arrow 1931, 414; Paulian 1934, 164. Chota Nagpur.
3. *H. chapmani* Paulian 1934, 163. Bangalore.
4. *H. fairmairei* Boucomont 1914, 254; Paulian 1934, 164. Singapore.
5. *H. fleutiauxi* Paulian 1945, 60. Tonkin.
6. *H. globosus* Boucomont 1925, 151. Philippines.
7. *H. heimi* Wassman 1918, 4, pl. 1, fig. 1 (*Cyclotrogus*); Arrow 1931, 414-415; Paulian 1934, 164. (Syn.: *Cyclotrogus nigrita* Wassman *loc. cit.*). Bengal; Bombay.
8. *H. oberthüri* Paulian 1934, 163. India.
9. *H. perroti* Paulian 1939, 70; 1943, 262, fig. 132; 1945, 160. Tonkin.
10. *H. philippinensis* n. sp. Philippines.
11. *H. rugatulus* Boucomont 1914, 253; Paulian 1934, 164. Singapore.
12. *H. stevensi* Arrow 1931, 414, 416, fig. 60; Paulian 1934, 164. Bengal.

Ponerotrogus annandalei Silvestri 1924 (Rec. Indian Mus. 26, p. 586, figs. 1-2), collected by Annandale in a nest of *Ponera tesserinoda* Mayr [now = *Bothroponera sulcata* (Frauenfeld)], under stones on the Barkuda Islands, Chilka Lake, seems to have characters similar to those of *Haroldius;* the two genera are possibly synonymous.

Provisional key to the species of *Haroldius*

1. Clypeus not emarginate, with no denticles on anterior margin; middle and hind spurs longer than four basal tarsal segments together; meso-metasternal suture straight; anterior tibiae quadridentate; 2.5 mm.; Barway ..... 1) *H. calcaratus* Janss.

1'. Clypeus dentate; middle and posterior spurs short, only longer than first tarsal segment; meso-metasternal suture arcuate 2

2. Basal portion of pronotum with a central triangular depression 3
2′. Basal portion of pronotum without such a depression. 5
3. Sides of pronotum with oblique striae near posterior margin; 2.5-3.0 mm.; Bombay ..2) *H. heimi* Wassm.
3′. Sides of pronotum punctate, not striate 4
4. Large, 3.5 mm.; Bengal .....3) *H. stevensi* Arr.
4′. Small, 1.5 mm.; Singapore ....4) *H. fairmairei* Bouc.
5. Bases of pronotum with oblique striae 6
5′. No such striae 7
6. Elytral interstriae each with one row of setiferous punctures; fore part of body cupreous, hind part black; 2 mm.; Tonkin .....5) *H. fleutiauxi* Paul.
6′. Interstriae each with two rows of setiferous punctures; black or brown; 2.5 mm.; Singapore 6) *H. rugatulus* Bouc.
7. Elytra glabrous 8
7′. Elytra pubescent 9
8. Elytral striae almost effaced on disc; metallic green with slight purplish sheen; 2 mm.; Philippines 7) *H. globosus* Bouc.
8′. Elytral striae evident even on disc; upper parts brown or cupreous; under parts lighter; basal part of antennae grayish; 1.9 mm.; Tonkin 8) *H. perroti* Paul.
9. Elytral interstriae each with one row of setiferous punctures; 3 mm.; Chota Nagpur 9) *H. cardoni* Paul.
9′. Interstriae each with two rows of setiferous punctures 10
10. One longitudinal sulcus immediately behind anterior denticles of clypeus; 3.5-4.0 mm.; Philippines 10) *H. philippinensis* n. sp.
10′. No such sulcus 11
11 Clypeus with strong, dense punctures; pronotum with strong, dense punctures on anterior half, and fine, scattered ones on posterior half; 3 mm.; Chota Nagpur .....11) *H. chapmani* Paul.
11′. Clypeal and pronotal punctures fine and sparse; 2.5-3.0 mm.; Chota Nagpur ....12) *H. oberthüri* Paul.

Acknowledgements

I am indebted to Dr. Philip J. Darlington, Jr., Curator of Insects, Museum of Comparative Zoology at Harvard College, for the opportunity of describing this interesting new form, as well as for the gift of two specimens to the Departamento de Zoologia. To Mrs. M. A. V. d'Andretta, of the latter institution, I am indebted for the drawings which illustrate the description. Dr. P. E. Vanzolini has kindly translated the manuscript into English.

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ADDITIONAL STUDIES ON *PSEUDOMYRMEX APACHE* (HYMENOPTERA: FORMICIDAE)

By William S. Creighton
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When *Pseudomyrmex apache* was described in this Journal in 1952 (1), the writer called attention to the fact that the incidence of this ant appeared to be greatest in the mountains of southeastern Arizona and that the incidence seemed to decrease sharply in areas south of that region. Additional field work in northern Mexico during the spring of 1953[1] has shown that this view is correct. Moreover, these studies indicate that the range of *apache* does not enter the tropics at all. This is a noteworthy distribution for a member of the genus *Pseudomyrmex*. The majority of the species in that genus are strictly confined to the Neotropical region and the few species which range into the southern United States are usually more abundant south of the Tropic of Cancer than north of it. The unique geographical position of *Ps. apache* is, therefore, a matter of unusual interest.

The new records for *apache* are presented below, together with a map showing the known range of this species:

Texas: Arsarca Canyon, Chinati Mts., (4800′) one colony *Quercus grisea.*

Nuevo Leon: China (600′) one colony in *Prosopis juliflora.*

[1]Field work done on a Guggenheim Fellowship.

Chihuahua: 3 miles south of Encinillas (4900′) one colony in *Q. emoryi;* 16 miles west of General Trias (5800′) two colonies, one in *Q. emoryi,* the other in a deciduous oak (sp?); 23 miles south of Parral (5500′) one colony in *Q. santaclarensis;* 34 miles south of Parral (5800′) one colony in *Q. santaclarensis.*

Durango: Villa Ocampo (5700′) one colony in *Q. fusiformis* or closely related species.

It should be noted that, except for the two colonies taken

west of General Trias, none of the stations in Chihuahua yielded more than a single colony. Many of the oak groves in Chihuahua, particularly those near the larger towns, have been denuded by wood-cutters. Despite this there are numerous areas where the groves are untouched. Those south of Parral are as extensive as any that the writer has encountered. Since *apache* will nest in at least three of the oaks present in this region, it follows that there are abundant nest sites available for it in central and southern Chihuahua. Yet the incidence of *apache* in these groves is low. In many groves the writer failed to find any specimens of *apache* and the few colonies which were secured are the result of repeated visits to the station at which they were finally taken. It may be recalled that identical collecting procedure in the oak groves of southeastern Arizona often produced from three to ten colonies per station.

The survey which gave the above records was carried south into Jalisco and Guanajuato and west through the Sierra Madre Occidental in Durango to the eastern border of Sinaloa. Except for the single record from Villa Ocampo, a small town five miles south of the Durango-Chihuahua border, no colonies of *apache* were taken south of the state of Chihuahua. The three southernmost records for *apache*, Villa Ocampo (Durango), China (Nueva Leon) and Monte Alto (Texas) are all near Latitude 26°. China lies about twenty-one miles to the south of the parallel, the other two stations lie a little to the north of it. Hence, there is a distance of at least one hundred and fifty miles between each of these stations and the Tropic of Cancer. The writer has repeatedly collected in the region between Latitude 26° and the Tropic of Cancer. The eighty-nine stations which have been visited extend from Tamaulipas through Nuevo Leon and southern Coahuila to the western border of Durango. Oaks were present at many of the stations and these oaks frequently contained arboreal ants. But the only record for *apache* coming from this region is the China record cited above. It is certain, therefore, that the incidence of *apache* south of Latitude 26° is even lower than it is in Chihuahua and it is probable that this ant is absent over much of the region between Latitude 26° and the tropics.

There are now enough records to show that *apache* occurs in a comparatively narrow band of territory, about twelve hundred miles long, which extends northwestward from the mouth of the Rio Grande River to southern California. Because of the skew of this band to the northwest it is difficult to give satisfactory northern and southern limits for the range of *apache*. If only latitude is considered the range runs from Lat. 33° 25′ to Lat. 25° 48′, a north-south extent of approximately 512 miles. But this method of delimiting the range is confusing, for it leaves out of account the fact that at any point along the east-west axis the width of the range is much less than five hundred miles. Indeed, in most places the band seems to be no more than two hundred miles wide and its maximum width does not exceed 370 miles. The distribution of *apache* throughout this long, narrow band is not uniform. The figures below show the total number of stations and colonies in each of the states where *apache* occurs.

	Stations	Colonies
California	1	2
Arizona	11	39
Chihuahua	5	10
Texas	3	4
Nuevo Leon	1	1
Durango	1	1

The very marked abundance of *apache* in the region near the southeastern border of Arizona is even more striking when it is considered that half of the ten colonies secured in Chihuahua came from a station in the extreme northwestern corner of the state (Nogales Ranch) which is only about thirty miles south of the U. S.-Mexico border. Since the most favorable part of the range of *apache* appears to be the region at the northern end of the Sierra Madre Occidental, it is instructive to consider the environmental conditions in this area.

The majority of the Arizona records for *apache* come from what Shreve (2) has called the "western xeric evergreen forest where oaks are dominant." This association is closely similar to LeSeur's (3) "*santaclarensis* consociation" in Chihuahua. There seems to be no essential climatic difference in the two biomes, the principal distinction be-

ing the dominant oak involved. In Arizona this is *Q. emoryi,* in Chihuahua it is *Q. santaclarensis.* Both these oak associations appear to reach their maximum development in areas where the average minimum annual temperature is not less than 15°F. or more than 20°F. In such areas light winter snows are not uncommon and minimum January temperatures as low as –6°F. have been recorded at several weather stations (4). The average annual rainfall in such areas is from 15 to 20 inches. Of this total more than half falls during the period from the first of July to the middle of September. Spring rains are exceptionally light, seldom comprising more than 10% of the total annual rainfall. Over most of the year there is a difference of at least 40°F. between the daily minimum and maximum temperatures. The humidity is low and the evaporation rate very high, since the area has an unusually large percentage of cloudless days.

Fig. 1. Map showing the known distribution of *Pseudomyrmex apache* in the southwestern United States and northern Mexico.

It seems clear from the above data that *apache* can tolerate lower temperatures than most of the other species of *Pseudomyrmex* which occur in the southern United States.

For the range of *Ps. elongata* is confined to areas where the average annual minimum temperature is 30°F. or more (southern Florida). That of *Ps. gracilis mexicanum* is limited to areas where the above temperature is 25°F. or more (southern Texas). *Ps. brunnea* is restricted to areas where the average annual minimum temperature does not go below 20°F., hence, while it occurs as far north as the Carolinas and thence south through the Gulf States into Mexico, it does not occur in southern Arizona. Only *Ps. pallida*, whose tolerance for low temperatures is equal to that of *apache*, does so, and *pallida* occurs through the Gulf States and north to the Carolinas.

The question immediately arises as to why, since *apache* can tolerate low temperatures as well as *pallida*, does not *apache* occupy the same area as the latter species. The restricting factor in this case appears to be rainfall rather than temperature. Although *apache* can live in areas where the average annual rainfall is as low as ten inches, it has never been taken in an area where the annual average rainfall is more than twenty-four inches. Beginning in west Texas (10 inches) and running east to Alabama (65 inches) there is a gradient of rainfall which increases to the east. It is interesting to note that the line which marks the area where the average annual rainfall passes 25 inches lies only a few miles north and east of the known eastern limit of the range of *apache*. It is further interesting to note that there is a comparable gradient of rainfall which increases southward from the Rio Grande Valley down the coastal plain of Mexico. This gradient begins with 25 inches in the Brownsville area, rises to 45 inches at Tampico and reaches 64 inches at Vera Cruz. As has been noted elsewhere, *apache* appears to be absent in this area. This might be expected if the ant is unable to tolerate an average annual rainfall in excess of 24 inches.

If, as seems to be the case, it is rainfall rather than temperature which plays the major part in determining the range of *apache*, some interesting speculations can be advanced as to how *apache* reached its present geographical position. It may be taken as axiomatic that *apache* came to southern Arizona from tropical sources. Since three of the species of *Pseudomyrmex* which occur in the southern

United States also occur along the coastal plain of eastern Mexico, this region has served as a pathway for northern migration of some members of this genus. It is possible that *apache* might have come north by this route and reached southern Arizona by turning west up the Rio Grande Valley. But if this has been the case then the climatic conditions along the eastern coastal plain in Mexico must have been different from what they are now or *apache* must have acquired its low tolerance for annual rainfall *after* it turned west from the coastal plain. In either case it is difficult to see why *apache* should have stopped its migration along the coastal plain at the Rio Grande River. For, on either count, areas north of the Rio Grande along the Gulf Coast should have been available to it. It can be argued that subsequent climatic change eliminated *apache* from the Gulf Coast except for the narrow strip of arid territory in the Rio Grande Valley area. The writer finds it difficult to believe that there would not be some traces of *apache* left in other parts of the Gulf Coast region under such circumstances. A much more acceptable explanation of the present range of *apache* can be made if it is assumed that the insect migrated north along the Mexican Plateau. The traces of this northern progress are present along the western edge of the Plateau, for the decreasing incidence of *apache* south through Chihuahua may be regarded in this light. There is additional evidence from the responses of *apache* that it has had a long and extensive acquaintance with conditions on the Plateau. It has been shown elsewhere (1) that *apache* customarily nests in sizeable limbs or the trunk of the tree, and that it rarely, if ever, nests in hollow twigs as do many species of *Pseudomyrmex*. It has also been shown (5) that larger limbs, particularly those stubs which point upward, accumulate much moisture after a rain fall. It seems clear that *apache* has lived under arid conditions long enough to have restricted its nesting habits to the parts of the tree which provide the maximum conservation of moisture. Coupled with this is the large tolerance of *apache* for various sorts of trees as nest sites. To date this ant has been taken from six species of evergreen oak, two species of deciduous oak and mesquite. It is interesting to note that

there is a succession of different species of oaks from north to south along the Plateau and that these oaks by no means form a continuous belt throughout this region. There are many areas where the oaks are replaced by mesquite. It may be no more than a coincidence that *apache* accepts several species of oaks as well as mesquite as nest sites but, at least, this behavior is precisely what would be expected if *apache* had migrated north along the Mexican Plateau.

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THE TAXONOMIC IDENTITY OF *MELITAEA* (*ATHALIAEFORMIA*)[1] *MAYI* GUNDER (LEPIDOPTERA, NYMPHALIDAE)

By Nicholas W. Gillham
Harvard University

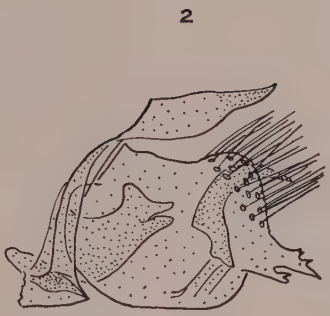
Ever since *mayi* was described by Gunder (1929) as a new species it has been suspected of being closely related to the *Melitaea* species of the *athalia* group, which is primarily Palearctic. However, heretofore nobody appears actually to have compared specimens of *mayi* with any of the Palearctic members of the group. In his original description Gunder, l.c., expresses the belief that *mayi* is very close to *M.* (*A.*) *athalia latefascia* Fixsen, basing his conviction on the insect figured on plate 66i of Seitz (1906) under the latter name. Verity (1941) concludes that the name *latefascia* is probably not applicable to Korean specimens previously listed under that name and that these specimens should be assigned to *M.* (*A.*) *coreae* Verity. This is important because he goes on to state that the species which Seitz, l.c., figured is the same thing as *coreae*. Therefore it can be seen that both Verity and Gunder equated *mayi* with the same species.

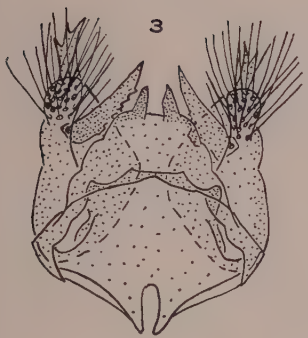
I have made quite a number of genitalic preparations, male and female, of *mayi* and of several of the Asian species

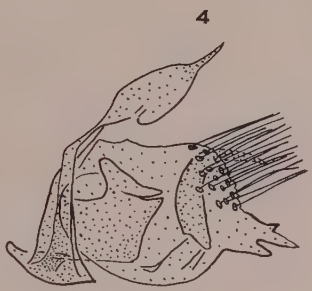
[1]Verity (1950) proposed the subgeneric name *Athaliaeformia* to include those members of the genus *Melitaea* belonging to the *athalia* group. He specifically lists *Melitaea mayi* as belonging to this subgenus.

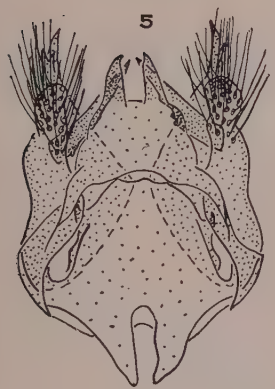
Explanation of Plate 2

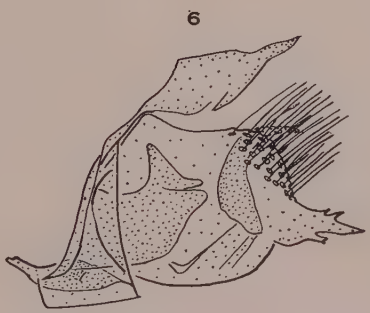
Fig. 1. Dorsal view of the male genitalia of *Melitaea* (*Athaliaeformia*) *ambigua* (=*mayi*) from Banff, Alberta (Genitalic Preparation 166). Fig. 2. Left lateral view of the genitalia in Fig. 1. Fig. 3. Dorsal view of the male genitalia of *M.* (*A.*) *ambigua* from Hsiolin, Manchuria (Genitalic Preparation 217). Fig. 4. Left lateral view of the genitalia in Fig. 3. Fig. 5. Dorsal view of the male genitalia of another specimen from Hsiolin, Manchuria (Genitalic Preparation 218). Fig. 6. Left lateral view of the genitalia in Fig. 5. All figures drawn to the same scale. The aedeagus has been removed and is not shown in any of the figures.











GILLHAM — MELITAEA MAYI

of the *athalia* group[2]. The preparations as well as the facies of *mayi* indicate that it does not belong to the same specific complex as *coreae,* as Verity thought, but is instead conspecific with another species, *M.* (*A.*) *ambigua* Menetries. I have figured the male genitalia of *mayi* (figs. 1 and 2) and of two specimens of *ambigua* (figs. 3, 4, 5, and 6) to show that they represent the same thing within the limits of individual variation. I have not figured the female genitalia because I can find no publication where the female genitalia of related species of the *athalia* group have been figured or studied other than for group characters as a whole. However, my preparations of the female genitalia of both *mayi* and *ambigua* show no real differences. The genitalia of *coreae,* on the other hand, appear to be quite distinct from those of *ambigua* and indeed the male genitalia indicate that this species is extremely close if not conspecific with what Verity, l.c., considers to be *M.* (*A.*) *britomartis* Assmann. The male genitalia of *coreae* that I have examined agree quite well with those of *britomartis* figured by Petersen (1945). I must admit that on the basis of my studies I strongly doubt the distinctness of *coreae* from *britomartis* but since I do not have the material available to confirm my doubts I must leave the question open. Lastly it should be noted that *coreae* has an earlier flight period (late May to the middle of June) than does *ambigua* or its Nearctic representative *mayi* (late June to early August).

The synonomy of *mayi* with *ambigua* provides us with a very interesting case of geographical distribution. My own examination of specimens and references in the literature indicate that *ambigua* ranges from Japan west to the Eastern Sayansk Mountains in Siberia and between the fourtieth and fiftieth parallels in the north-south direction in the Palearctic region. In the Nearctic region its distribution is drastically reduced and the only records that I can

[2]In this connection I should like to thank Dr. F. H. Rindge of the American Museum of Natural History, Dr. P. J. Darlington of the Museum of Comparative Zoology, Mr. H. K. Clench of the Carnegie Museum, and Mr. J. A. G. Rehn of the Academy of Natural Sciences of Philadelphia for making it possible for me to examine specimens under their care.

find are for the area around Banff, Alberta, and Smithers, British Columbia.

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GEOGRAPHICAL DISTRIBUTION OF THE GENUS *MYRMOTERAS*, INCLUDING THE DESCRIPTION OF A NEW SPECIES (HYMENOPTERA: FORMICIDAE)

By Robert E. Gregg

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In 1925, Carlo Emery summarized the accumulated knowledge concerning the ant genus *Myrmoteras* in the Genera Insectorum, Fasc. 183, p. 36, and listed four species with their general distribution in portions of Malay and the East Indies. The following brief anatomical diagnosis of the genus is adapted from Emery, and gives the important distinguishing characteristics.

Worker: monomorphic.

Head relatively large and angular; eyes enormous, very convex, covering one-half to three-quarters of the sides of the head; ocelli present; a deep, transverse groove behind the ocelli separates a prominent occipital bulge from the vertex; the bulge shows a marked median depression. Clypeus produced and with a sinuate anterior border continuing into rather sharp clypeal teeth laterally. Frontal area and epistomal suture distinct. Mandibles slightly longer than the head, approximated at their bases, narrow and almost straight, armed with long teeth evenly spaced along the medial border; the mandibular apex with two quite long, sharp teeth, the terminal one representing the recurved tip of the mandible; between these two teeth two small denticles may be present. Maxillary palps 6-segmented; labial palps 4-segmented. Frontal carinae obsolete. Antennal fossae remote from the epistomal suture; antennae filiform and composed of 12 segments.

Thorax resembles that of *Oecophylla;* pronotum and epinotum prominent and convex, mesonotum depressed and

Text-figure 1. *Myrmoteras karnyi* sp. nov. A. Profile of worker. B. Head of worker, dorsal view.

saddleshaped; mesonotal tubercles pronounced and their spiracular openings conspicuous. Petiole more or less pedunculate anteriorly and posteriorly, and provided with a thick, vertical scale. Tarsi long; tibiae more or less inflated.

Gaster with five visible segments; sting absent; pore of formic acid gland surrounded by a circlet of small hairs.

Female: resembles the worker; winged.

Anterior wing with the radial cell about equal to the cubital cell; a small discoidal cell.

Male: smaller than the female.

Head large, rounded posteriorly, and without transverse cephalic groove and occiptal bulge. Mandibles very short and rudimentary; without teeth. Antennae with 13 articles. Eyes, clypeus and antennal insertions as in the worker. Thorax, petiole, gaster and wings as in the female. Genitalia almost the same as in *Prenolepis*. Proventriculus provided anteriorly with a concave calyx, of which the sepals are thick, heavily chitinized, and reflected outwardly. *Genotype*: *Myrmoteras binghami* Forel, 1893. Burma (☿).

Two new species were described and much additional information about these ants was provided by Creighton, when in 1930 he wrote at considerable length concerning the feeding relationships and other aspects of their behavior. He gave attention to the possibility of the phenomenon of retrosalience (backward leaping) occurring in *Myrmoteras*. Such behavior has been observed in *Odontomachus, Anochetus* among the ponerines, and in *Strumigenys* among the myrmicines. These genera, and also certain others in the tribe Dacetini, such as *Acanthognathus, Orectognathus, Microdaceton* and *Epitritus*, according to Creighton, may be described as "trapjawed". That is to say, they have elongated, narrow mandibles, articulated near the center of the anterior border of the head, and armed with various types of dentition. The mandibles when widely opened (extending in a plane at right angles to the long axis of the head), are operated by long trigger hairs attached either on the labrum or basal borders of the mandibles. These hairs when stimulated by appropriate

prey cause the mandibles to snap shut, impaling small insects or other arthropods within their grasp. The closure is affected by powerful mandibular muscles, and the enlargement of these muscles has caused a protrusion and elongation of the occipital region of the head for their accommodation. The retrosalient behavior is attributed by Creighton to the effect of the mandibles snapping shut upon some object too hard and too large to be included in their bite. It is an ecological by-product, and he believes has no true functional significance in the lives of these ants.

Field observations on *Myrmoteras* are extremely scant, and so far no one has seen the feeding activities or retrosalience in any of the species. It can only be inferred from the structure of the *Myrmoteras* head and jaws, and the presence of long trigger hairs, that the behavior is similar to that known to occur in the various other trap-jawed genera mentioned above.

Wilson (1953) has recently added considerable interesting information about the feeding habits of North American dacetine ants, and has confirmed the previously described hunting behavior of these ants in which the prey (Collembola and a few other arthropods) are caught by the convulsive snap of widely opened mandibles.

Thus we appear to have some remarkable cases of convergence associated with trophic adaptations among ants. Two genera in the Ponerinae, a number of myrmicine genera, and one in the Formicinae have evolved independently food-seizing mechanisms of astonishing similarity, and these analogies are adequately described and illustrated in Creighton's account. A fertile field of ecological and behavioristic studies is available for any myrmecologist with the opportunity to observe *Myrmoteras* in its natural habitat.

The following is a description of a new species belonging to this genus.

Myrmoteras karnyi sp. nov.

Worker: Length 3.6 mm.; head index 0.92

Of the seven species heretofore recognized in the genus, *Myrmoteras karnyi* is most closely related to *M. binghami* by virtue of possessing a frontal furrow and by the pres-

ence of cephalic striations or rugulae. Also, two minute denticles between the apical and the penultimate teeth constitute a further similarity. The lack of a furrow in *barbouri* and *mjoebergi,* as well as the nature of the head sculpture and the mandibular characters in these species, at once separate them from the new species. The forms with a frontal furrow, namely, *binghami, donisthorpei, williamsi* and *bakeri,* may all be distinguished from *karnyi* in various ways. In *bakeri* the dorsum of the head is entirely smooth, while in *williamsi* it is entirely coriaceous or covered with a sculpture of minute and contiguous punctures, giving the surface a matte appearance. The frons and clypeus of *donisthorpei* and *binghami,* according to Creighton, are reticulo-striate, but in the latter species the striae are feebler and rather fragmented. The head of *karnyi* possesses striations also, but these are less wavy, being curved only where they pass around the antennal insertions, and furthermore, they are confined to the frons. In addition, *karnyi* differs from *binghami* in that the mandibles each bear ten teeth (rather than nine), apart from the minute denticles between the two terminal teeth. The two basal teeth are themselves mere denticles, but nevertheless distinct, and all teeth show a gradual increase in size outward toward the apex of the mandible. The clypeus presents lateral furrows or depressions separating an elevated median portion from the marginal flanges, and such a condition seems to be lacking from *binghami.* The thorax of *karnyi* also contrasts noticeably with that of *binghami,* for the pronotum in profile is higher and more convex, and the mesonotum is decidedly saddle-shaped and narrowed, recalling the condition in *williamsi,* with strong longitudinal rugae traversing it. The mesonotal spiracles are sizable openings and are raised on prominent tubercles. The epinotum is as high as the pronotum, very convex resembling in general appearance the same structure in *Myrmecocystus,* and the angle between the basal and declivious faces is only weakly indicated. The petiole has short anterior and posterior peduncles, with a high, vertical scale, the front and rear surfaces of which slope slightly. The petiolar crest is flat but is inclined a little posteriorly and ventrally.

Holotype: a single worker in the collection of the Zoologisch Museum en Laboratorium, Bogor (formerly Buitenzorg), Indonesia.

Type locality: Island of Sipora, in the Mentawai Archepelago off the west coast of Sumatra. The specimen was collected by H. H. Karny, #22g, on October 31, 1924.

The following key has been modified from Creighton (1930) and Wheeler (1933), and includes the diagnostic features for the eight known species of the genus.

Key to the species of *Myrmoteras*

1. Frontal furrow well developed, extending back to the median ocellus 2
   Frontal furrow absent or represented only by an obsolete impression which does not extend beyond the anterior third of the head 6
2. Head opaque, completely coriaceous, except the occipital fold. Length 3.9 mm. ..... *williamsi*
   Head smooth and shining; sculpture if present consisting of striae on the frons and clypeus 3
3. Head entirely smooth. Female: length 4 mm. ..... *bakeri*
   Frons, or frons and clypeus striate 4
4. Mandibles 14-toothed; denticles between apical and penultimate teeth not well developed. Female: length 4.5 mm. ..... *donisthorpei*
   Mandibles 9 or 10-toothed; denticles between apical and penultimate teeth well developed 5
5. Mandibles 9-toothed; frons and clypeus striate. Length 5.3 mm. ..... *binghami*
   Mandibles 10-toothed; frons striate, clypeus smooth. Length 3.6 mm. ..... *karnyi*
6. Head completely smooth and very shining. Length 5-5.6 mm. ..... *mjoebergi*
   Head subopaque, finely and feebly coriaceous 7
7. Mandibles with a pair of denticles between the apical and penultimate teeth; meso- and epinotum opaque. Length 6 mm. ..... *kemneri*
   Mandibles without denticles between the apical and penultimate teeth; meso- and epinotum shining. Length 6.9 mm. ..... *barbouri*

The genus *Myrmoteras* appears to belong to an archaic branch of the formicine subfamily, and according to Emery represents the relicts of an otherwise extinct group. The structure of the gizzard is obscure, though it is apparently primitive and not developed into the complicated mechanism found in the higher genera of the Formicinae. From Forel's figure (reproduced in the Genera Insectorum), it can be seen that the sepals of the proventriculus are only slightly reflected over the anterior end of the bulb, and appear to be similar to the condition observable in other primitive formicine genera (such as *Anoplolepis, Plagiolepis, Melophorus* and *Myrmelachista*) which are also near to the base of the stem from where these genera and other formicines have arisen. Nevertheless, *Myrmoteras* and an allied genus, *Myrmecorhynchus,* are considered by Emery sufficiently aberrant to be placed in a separate section of the subfamily, and his decision is based upon the nature of the gizzard. But he states that the organ in *Myrmecorhynchus* is more like those of the primitive genera mentioned above, and that the proventriculus of *Myrmoteras* is perhaps transitional to the condition seen in the more advanced genera.

The anatomy of the gastric valves in *Myrmoteras* are too poorly understood to allow an unequivocal phylogenetic placement of this genus, but whatever its eventual position, it is certain that these ants form a very unusual group. The most obvious facts in this connection are the elongate and sharply dentate mandibles, with trigger hair mechanisms, the modification of the cephalic structure to accommodate the mandibular muscles, and the enormous eyes fitted with very numerous facets. These structural characters are clearly associated with feeding habits, as can be ascertained from similar and convergently evolved morphological traits in other ant genera. These interpretations, together with a probably parallel but subsidiary accompaniment of the phenomenon of retrosalience, as deduced by Creighton, show that *Myrmoteras,* though undoubtedly archaic, has produced some very specialized structures and behavior associated with its nutritional requirements and feeding methods. The mixture of primitive and highly advanced adaptive features is not peculiar to these ants, but

has turned up independently in diverse and unrelated taxonomic groups. It may be regarded as an indication of the resilience of the hereditary composition of living material, enabling the organism, through selection, to make necessary adjustments to, and exploitation of, the available habitats, irrespective of evolutionary primitiveness or specialization which the animal may show in regard to its closest relatives.

Text-figure 2. Estimated distribution of the genus *Myrmoteras*. Malay Peninsula, Philippines, Borneo, Java, and the Island of Sipora.

Apart from the extraordinary adaptations displayed by *Myrmoteras,* we are also concerned with geographic distribution of this group. The distribution suggests that of an ancient and perhaps once more widespread and flourishing genus. The modern representatives are few in number (8 species), and appear to be very rare as individuals even in their geographic headquarters, if we may judge from the paucity of material that has found its way into collections. The group was present, presumably, during the Tertiary Period, but there is no fossil evidence to confirm this assumption. In his study of the ants preserved in

the Baltic Amber, Wheeler (1914) found that a number of Indomalayan genera and others which are tropicopolitan at the present time, had a much broader range, including northern Europe, during the Oligocene. However, *Myrmoteras* was not among them. Such negative information cannot show that these ants had not yet evolved, and on the other hand the primitive nature of the genus is a strong argument in favor of its origin at least by the Eocene or perhaps in Cretaceous times. Its absence from the Baltic Amber is a matter of conjecture, for advanced formicine genera like *Prenolepis, Lasius, Formica,* and *Camponotus* are abundantly represented and should have evolved no earlier than *Myrmoteras.* In this connection it should be noted that *Plagiolepis* is represented by a number of amber species. Peculiarities of behavior could hardly have kept *Myrmoteras* out of the resin traps for a great many ants of diverse habits are known from the amber. It seems reasonable to conclude that either the species of *Myrmoteras* were so rare (as they are today) that their chances of being preserved in fossil resin were drastically reduced, or that the range of the genus did not include the localities where amber was being formed. The latter possibility appeals to the writer to be much more probable.

The present distribution of these insects is outlined briefly in the list below. The reader is referred also to the adjoining map.

Myrmoteras bakeri Wheeler. Sandakan, Borneo — Type locality

Myrmoteras binghami Forel. Thaungyin Valley, Tenasserim, Burma — Type locality

Myrmoteras barbouri Creighton. Singdanglalia, Java— Type locality

Myrmoteras donisthorpei Wheeler. Mt. Matang, Sarawak, Borneo — Type locality

Myrmoteras mjoebergi Wheeler. Mt. Tibang, Dutch Borneo — Type locality

Myrmoteras kemneri Wheeler. Tjibodas, Java — Type locality

Myrmoteras karnyi Gregg. Sipora, Mentawai Islands— Type locality

Myrmoteras williamsi Wheeler. Los Baños, Philippine Islands—Type locality; Dumaguete, Philippine Islands

Dr. Brown informs me (*in litt.*) of an additional record of *Myrmoteras* taken from the island of Hainan (Ta Han, and collected by J. L. Gressitt), which thus considerably extends the known range of the genus. The specimen is a male, and has not been identified definitely with any of the known species. It may belong to *donisthorpei,* but until it can be associated with other castes, its determination is uncertain.

The scarcity of these ants is readily apparent from the above list in that all but one are known only from the type localities, and very little material beyond the type specimens seems to be known. *M. bakeri* is represented by the female and male, *donisthorpei* by the female caste, *binghami, barbouri, mjoebergi, kemneri,* and *karnyi* by the worker caste, and *williamsi* by worker, female, and male castes.

Some of the differences among these species may seem rather slight, and might be interpreted as indicating subspecific status. Wheeler thought this might be the case between *barbouri* and his new form *kemneri,* but in an ancient stock it appears more likely that the surviving species are relicts of a formerly broadly dispersed fauna, and a group in which the process of speciation had completely sorted out and separated an array of forms rather than one which presented the early (subspecific) stages of differentiation. For this reason, the writer is inclined to the belief that the eight species or forms so far discovered will be confirmed as specifically distinct when more extensive information is available.

It will be noticed that the distribution map implies complete occupancy by *Myrmoteras* of Borneo, Java, the Philippines and the Malay Peninsula. This was done despite our fragmentary knowledge and the very limited actual localities where the ants have been taken, because the genus if present on an island at all, probably exists at numerous stations. In addition, such relatively primitive ants may be holding on in the face of a more advanced fauna of higher formicines, in which case they would be expected to occur in the undisturbed forest areas rather than locations

subject to human interference, and when these forests are more thoroughly collected it seems certain many more specimens of *Myrmoteras* will come to light. The new species, *karnyi,* is from an island near the coast of Sumatra, consequently it is logical to suppose that the genus is represented by this species or some other form native to this large island of the East Indies, especially since adjacent major islands, and Malay, possess the ants. However, in the absence of any records known to me from Sumatra, it is thought best to leave the island unshaded.

Acknowledgement is due Dr. William L. Brown for the opportunity to describe and figure the specimen upon which the latest species of *Myrmoteras* is based. Dr. Creighton has also examined the specimen and I have had the benefit of his opinion in proposing the new form.

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THE BALTIC AMBER MECOPTERA[1]

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The scorpion-flies and their relatives have a long and varied geological record. They are well represented in Permian and Mesozoic strata, which were formed when the order was more extensive than it is now, but poorly represented in Tertiary deposits. Even the Baltic amber, which has contributed enormously to our knowledge of Tertiary insects in general, has yielded very few Mecoptera. Seven specimens, mentioned by Hagen and Pictet a century ago, constitute the only published record of the order in the amber.

The nineteen specimens forming the basis of the present paper have been accumulated since 1931, when my interest in the Mecoptera was first aroused. All of these fossils, except for one belonging to the British Museum, are part of the Harvard collection of amber insects contained in the Museum of Comparative Zoology.[2]

The seven species represented in the collection belong to the living families Panorpidae and Bittacidae. This is the oldest record of the Panorpidae but not of the Bittacidae, which have already been found in Eocene deposits (Green River). The amber species also belong to extant genera: *Panorpodes*, *Panorpa* and *Bittacus*. The occurrence of the first of these is especially interesting since it now has a very restricted Asiatic distribution. Noteworthy, also, is the close similarity of these Oligocene Mecoptera to living species. This was observed by Hagen (1856), who pointed out that he had difficulty in distinguishing one of the amber species of *Bittacus* from the European *B. italicus*. A comparable similarity between the

[1]Published with a grant from the Museum of Comparative Zoology at Harvard College.

[2]A comparable collection of amber Neuroptera has also been accumulated and will be considered in a subsequent paper.

amber and extant faunas has previously been observed in most other insect families.

Family Panorpidae

Genus *Panorpodes*

Panorpodes MacLachlan, 1875, Trans. Ent. Soc. London: 188.

Electropanorpa Carpenter, 1931, Journ. N. Y. Ent. Soc., 39:409.

This genus, which is known extant only in Japan and Korea, is represented in the Baltic amber by two species. The generic characteristics are distinctive and can clearly be seen in specimens of both species: a short rostrum, unmodified 7th and 8th abdominal segments of the male, and a definite pleural membrane on the 6th abdominal segment of the male. The occurrence of *Panorpodes* in the Baltic amber, remote from the regions which it now occupies, is noteworthy, for it adds another example of the presence of an existing Asiatic genus in the Baltic region during the Tertiary.

The genus *Electropanorpa,* which I erected for *Panorpa brevicauda* Hagen, now seems to me to be inseparable from *Panorpodes.*

Panorpodes brevicauda (Hagen)

(Figure 1)

Panorpa brevicauda Hagen, 1856, *in* Berendt's Bernstein befindl. organ. Reste Vorw., 2(1) :91; pl. 8, fig. 21.

Electropanorpa brevicauda Carpenter, 1931, Journ. N. Y. Ent. Soc., 39:409.

Fore wing: length, 11.5-13 mm.; width, 3.5-4 mm.; length of rostrum, 2 mm. Body generally dark brown; wings slightly yellowish, but clear and without maculations; venation as in *Panorpodes,* R1 being posteriorly curved just below the end of Sc; male genital bulb globular, not slender as in *paradoxa;* forceps also are more slender than those of *paradoxa;* hypovalvae extending only to about the base of the forceps. The dorsal surface of the genital bulb in not visible in any of the specimens which I have seen.

The collection at hand contains three males of this insect, all more or less complete (M.C.Z. nos. 5103, 5104, 5105). Hagen based his description of the species on two specimens, one well-preserved male, and the other a fragmentary specimen consisting mainly of the wings.

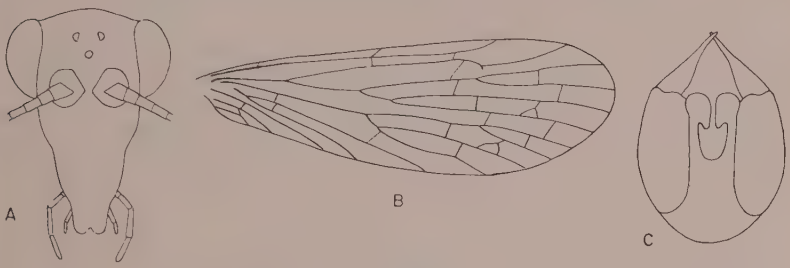

Figure 1. *Panorpodes brevicauda* (Hagen). A, Front view of head; B, fore wing; C, genital bulb of male. All drawings based on specimen no. 5103, M.C.Z.

Hagen's assignment of *brevicauda* to *Panorpa* is not surprising, since at that time (1856) the only two living genera known in the Panorpidae were *Panorpa* and *Choristа*. That Hagen was aware of the peculiarities of the abdomen is clear from his account and from the meaning of the specific name which he used. In my 1931 paper, I called attention to the affinities of *brevicauda* with the species of *Panorpodes*, but concluded from Hagen's figured specimen that the radial sector and media of *brevicauda* had six and five branches respectively, more than is found in living panorpid genera. The additional specimens of *brevicauda* now at hand show that this is not consistently so: the radial sector has six branches in one specimen, five in another, and four in the third; the media has four branches in all specimens.

Panorpodes hageni, n. sp.

Fore wing: length, 13.5 mm., width, 4 mm.; length of rostrum, 2 mm. Body generally dark brown; wings uniformly dark brown from base to apex, with three transverse hyaline bands and a few hyaline spots distally; venation as in *brevicauda;* the genital bulb has the same form

as that of *brevicauda,* but details cannot be discerned because of debris covering part of the body.

Holotype: No. 5106, M.C.Z.; Baltic amber collection; this consists of a complete male.

The generic position of this insect is shown by the structure of the sixth and seventh abdominal segments and the short beak. It is separated from *brevicauda* on the distinctive wing-markings, the wing being essentially dark brown, with hyaline bands. The markings of *Panorpa trizonata* are similar, but include more hyaline areas than those of *hageni.* The wing-markings of the living *Panorpodes paradoxa* show great variability, which has caused at least six synonymous species to be established (*apicalis, decorata, notata,* etc.); but even the most heavily marked individuals do not approach the specimen on which *hageni* is based.

Genus *Panorpa*

Panorpa Linne, 1758, Syst. Nat., **10**:551.

The Baltic amber collection includes two species of this genus; a third species may be present, but the specimen (no. 5110) is too poor to permit description. The occurrence of *Panorpa* in the amber is not at all surprising, for it is now the dominant genus of the order Mecoptera, with a very wide distribution. Three species of the genus have been described from mid-Tertiary deposits of Europe and North America, but their reference to *Panorpa* is not necessarily correct, since only their wings are known. The Baltic amber specimens show clearly the head and abdominal structures peculiar to the genus.

Panorpa obsoleta, n. sp.

(Figures 2A and 4A)

Fore wing: length 12 mm.; width, 3 mm.; length of rostrum, 3 mm. Body generally light brown; wings with light yellowish membrane and gray-brown maculations; apical band complete; pterostigmal band reduced to an elongate oblique spot; basal band reduced to two large spots; in the type specimen, Rs has five branches, M, four; 7th and 8th abdominal segments short (fig. 4A), genital bulb rounded, hypovalvae extending to just beyond the

base of the forceps, details of which are not discernible in the fossil; hypovalvae broad, resembling those of the living Japanese species, *Panorpa pryeri* McL.

Holotype: No. 5107, M.C.Z., Baltic amber collection. This is a whole specimen (♂), though parts of the body and wings are obscured by opaque amber.

The wing-markings of this insect, especially the form of the pterostigmal band, are very distinctive.

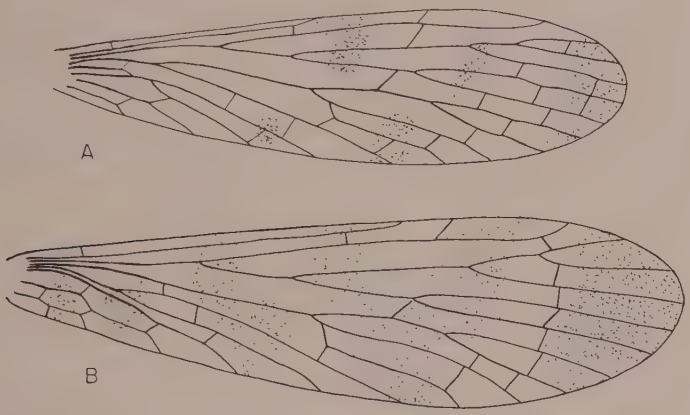

Figure 2. A, Hind wing of *Panorpa obsoleta,* n. sp. (holotype); B, fore wing of *Panorpa mortua,* n. sp. (holotype).

Panorpa mortua, n. sp.

Fore wing: length, 14.5 mm.; width, 4 mm.; length of rostrum, 3 mm. Body generally dark brown, almost black; wing with hyaline membrane and very dark brown or nearly black markings, resembling those of the Japanese *P. klugi* McL.; apical band complete; pterostigmal band complete or nearly so; basal band broad and extensive, almost touching the pterostigmal band; first and second basal spots apparently fused; in the type specimen Rs has five branches and M, four; abdomen with the characteristic form of the genus; the shape of the subgenital plate not discernible.

Holotype: No. 5108, M.C.Z., Baltic amber collection; this is a whole and very well preserved specimen (♀). There are two other females of the species in the amber collec-

tion (nos. 5109 and 5119), with similar dimensions and wing markings.

Family Bittacidae
Genus *Bittacus* Latr.

Bittacus Latreille, 1805, Hist. Crust. Ins., 8:20.
Electrobittacus Carpenter, 1931, Journ. N. Y. Ent. Soc., 39:410.

This is a very widely distributed genus at present, although it includes only about fifty species. The amber collection contains the three[3] species described below; a fourth species is also present but is not being described because of the fragmentary nature of the single specimen which represents it. The occurrence of this number of species is striking, since only two species now exist in all of Europe; it substantiates evidence provided by other fossils that the family Bittacidae was more extensively developed during early Tertiary times than at present.

An additional point of interest about the amber *Bittacus* is the small size of certain species. The wing expanse of most living members of genus is at least 34 mm., although in a few species, such as *B. apicalis*, it may be 30 mm. One of the amber species described below (*minimus*) has a wing expanse of 24 mm., and is, I believe, the smallest species of the genus known.

Bittacus fossilis, n. sp.
(Figures 3A and 4B)

Bittacus antiquus Hagen, 1856, *in* Berendt's Bernstein Befindl. organ. Reste Vorw., 2(1) :92; pl. 8, fig. 22 (nec *Bittacus antiquus* Pictet, 1854, Traité Paléontol., :379; pl. 40, fig. 26).

Fore wing: length, 14.5-16 mm.; width, 3.3-3.8 mm.; body light brown; wings uniformly light brown, except for pterostigma, which is slightly darker; no wing markings; venation and wing shape as in figure 3A; a single pterostigmal cross-vein; cubital cross-vein below first fork

[3]This figure does not include *B. validus* Hagen, which, as I have previously pointed out (1931), can on'y doubtfully be assigned to the Mecoptera.

of M; no anal cross-vein. Male genitalia as in figure 4B; the copulobi, (cl) with deeply incised margins dorsally, forming a posterior lobe; paraprocts (pr) large; spiral filament (sf) forming only part of a single loop, much as in *apicalis*.

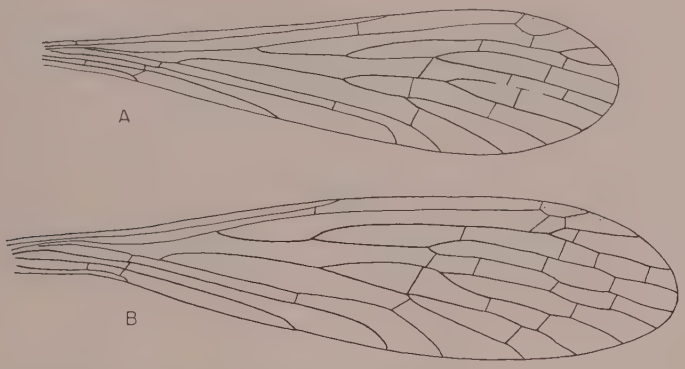

Figure 3. A, Fore wing of *Bittacus fossilis*, n. sp. (holotype); B, fore wing of *Bittacus succinus*, n. sp. (holotype).

There are four amber specimens which I am identifying as this insect: No. 5117, a complete male (fore wing, 15.5 mm. long), with virtually all body structures preserved, including genitalia; No. 5118, a female (fore wing, 15 mm. long), complete except for one pair of wings; No. 5111, a female (fore wing, 16 mm. long), complete except for one pair of wings.

I am convinced that this is the species of which Hagen had four specimens (females) and which he discussed under the name of *Bittacus antiquus* Pictet. The latter was first technically described by Pictet in 1854 (p. 379; pl. 40, fig. 26) from a single, poorly preserved specimen. Hagen reproduced Pictet's original figure and added one of his own (pl. 8, fig. 22). The most notable aspect of Pictet's drawing is the very short beak (much like that of *Panorpodes*); it was this characteristic that induced me to establish the genus *Electrobittacus* for *antiquus* in 1931. Hagen expressed doubt about Pictet's representation of the head, but did not state what his specimens showed in this respect. Significant, also, is Pictet's draw-

ing of the whole insect, depicting a form of wing entirely foreign to the bittacids, but similar to that of most Trichoptera. Hagen's drawing of the wing of one of his specimens, however, is that of a typical *Bittacus* and agrees in venation and size with the wings of a species in the Harvard collection. Since none of the bittacids in this collection has a short beak or a wing-form like that shown in Pictet's figure, I believe that the four specimens which Hagen identified as *antiquus* were not that species. I also believe that Pictet's type specimen of *antiquus* is not a true bittacid; it may have been a trichopteron, but since its identity is very uncertain, I propose that *antiquus,* which now carries the generic name *Electrobittacus,* be considered a *nomen dubium.* The species which Hagen presumably had is described here as *fossilis.*

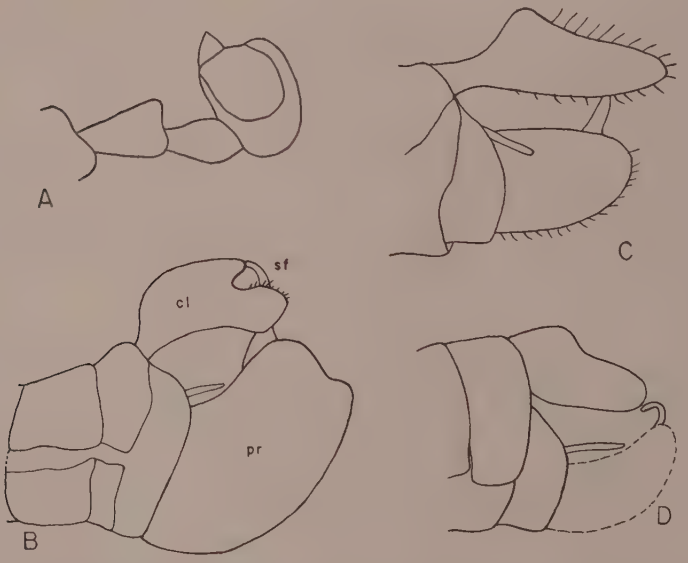

Figure 4. A, Seventh and eighth abdominal segments and genital bulb of *Panorpa obsoleta,* n. sp. (♂, holotype); B, terminal part of abdomen of *Bittacus fossilis* (♂, holotype); C, terminal part of abdomen of *Bittacus succinus,* n. sp. (♂, holotype); D, terminal part of abdomen of *Bittacus minimus,* n. sp. (♂, holotype).

Bittacus minimus, n. sp.
(Figure 4D)

Fore wing: length, 11.5-13 mm.; width, 3 mm.; body light brown; wings uniformly light brown, much as in *antiquus;* no wing-markings; venation as in *fossilis,* with a single pterostigmal cross-vein; cubital cross-vein below first fork of M; no anal cross-vein. Male genitalia as in figure 4D; copulobi short, without a dorsal incision, broad basally; paraprocts apparently small (not clearly preserved); spiral filament small, forming only part of a single loop.

Holotype: No. 5113, M.C.Z., Baltic amber collection; a nearly complete male, clear dorsally but cloudy ventrally; length of fore wing, 13 mm.

In addition to the type, there are three females in the Harvard collection which I believe belong here: No. 5114, a complete and well preserved female, with a wing length of 13.5 mm.; No. 5116, another complete female, with a wing length of 11.5 mm.; and No. 5115, an exceptionally well preserved female, with a wing length of 11.5 mm. There is also a nearly complete female, apparently this species, in the amber collection of the British Museum (No. IN 18855); it has a wing length of 13 mm.[4]

The male on which this species is based is readily distinguished from that of *fossilis* by the different form of the copulobi; but the wings of the two species show no differences, in either venation or form. On the basis of the material at hand, however, I consider *minimus* to be the smaller of the two and I have placed the above-mentioned females here on that basis.

Bittacus succinus, n. sp.
(Figures 3B and 4C)

Fore wing: length, 17 mm.; width, 5 mm.; body and wings light brown; distal part of wings with nebulous dark areas; venation as in figure 3B; two pterostigmal cross-veins; cubital cross-vein below fork of M; no anal

[4]I am indebted to the authorities of the British Museum for the loan of this specimen.

cross-vein. Male genitalia as in figure 4C; copulobi long, narrowed at base, abruptly indented; paraprocts relatively small, not projecting beyond copulobi; spiral filament apparently forming an incomplete loop.

Holotype: No. 5112, M.C.Z., Baltic amber collection; a complete male.

This is a very distinctive species, larger than the two preceding ones and readily recognized by the two pterostigmal cross-veins.

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